

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

The Abstract and Claim 4 are each objected to. To obviate the objections, the term "detects" in the Abstract is rewritten as --defects-- and the term "detect" in Claim 4 is rewritten as --defect--. Thus, the objections should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the objections. *✓✓*

Claims 9 and 10 are objected to as being in improper form because a multiple dependent claim cannot depend from any other multiple dependent claim. To obviate the objection, Claims 9 and 10 are each amended to depend from single dependent claim 1. Thus, the objection to Claims 9-10 should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the objection. *✓✓*

Claims 1, 3, 5-7 and 9-10 are rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,057,360 ("Osaka"). Applicants respectfully traverse the rejection because Osaka fails to teach or suggest all the limitations of the claimed invention. In particular, Osaka fails to suggest the independent Claim 1 limitation of "a ceramic sheet having not more than 5 *X*
defects in an area having a length of 30 mm or less, the defect being detected based on an image obtained with a charge coupled device (CCD) camera". In addition, Osaka fails to suggest the independent Claim 5 limitation of "sandwiching a green sheet to be baked by *X*
spacers; and baking the green sheet to be baked while being sandwiched, wherein the spacer
is a green sheet or a calcined sheet comprising spherical ceramic particles having an average
particle diameter of 0.1 to less than 5 µm as a main component".

To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP §2143.

According to the present invention, the term "defect" means a foreign matter present on the surface or inside the ceramic sheet, a flaw on the surface thereof and a stain adhering to the surface thereof. Specification at page 10, lines 3-6. As to the flaws formed on the ceramic sheet, there are various kinds and shapes, for example, line-shaped flaws formed by scratching the ceramic sheet, chain-shaped flaws, dot-shaped flaws which look as if they are formed by pricking the ceramic sheet with a needle, round-shaped flaws and pinholes. Specification at page 11, lines 4-8.

The spherical ceramic particles used in the present invention mean particles of which spherical shape can be visually recognized by a microphotograph. Specification at page 17, lines 16-18. Specifically, when the ratio of its major axis to its minor axis (the major axis/the minor axis) is defined as W, the spherical ceramic particles have a W value of 1 to 3 ($1 \leq W \leq 3$), preferably 1 to 2 ($1 \leq W \leq 2$) and more preferably 1 to 1.5 ($1 \leq W \leq 1.5$).

Specification at page 17, lines 18-22.

The attached micrograph Exhibits show, respectively, spherical ceramic particles (particle diameter: $0.7 \mu\text{m}$) used in the present invention (NS-SAL), and alumina having no definite form (product of Showa Denko Co., Ltd., particle diameter $55 \mu\text{m}$)(AL-15-2), which was used in Comparative Example 1 of the present invention.

Independent Claim 1 recites a ceramic sheet having not more than 5 defects in an area having a length of 30 mm or less, the defect being detected based on an image obtained with a charge coupled device (CCD) camera.

Independent Claim 5 recites a method for producing a ceramic sheet, comprising the steps of: sandwiching a green sheet to be baked by spacers; and baking the green sheet to be baked while being sandwiched, wherein the spacer is a green sheet or a calcined sheet

comprising spherical ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a main component.

The present invention provides a ceramic sheet having uniform quality over its entire surface with a decreased number of defects such as foreign matters and flaws. Specification at page 6, lines 21-24. In addition, the present invention provides a method for producing the above-identified ceramic sheets by baking a plurality of green sheets while effectively preventing the generation of defects such as flaws. Specification at page 6, line 26 to page 7, line 3. The present inventors have found that the use of a green sheet or a calcined sheet mainly including spherical ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a spacer is effective in suppressing the flaws generated in the step of baking the green sheet. Specification at page 7, lines 5-9. This is because the use of this spacer can lower the frictional resistance between the spacer and the green sheet to be baked. Specification at page 7, lines 9-11. As a result, the green sheet for ceramic sheet can shrink with sliding smoothly on the spacer surface during dewaxing and/or sintering in the baking step. Specification at page 7, lines 12-14.

In contrast to the claimed invention, Osaka discloses a ceramic precursor composition, comprising (A) at least one fine ceramic powder selected from the group consisting of zirconia and alumina and having an average particle diameter in the range of 0.01 to 2 microns and (B) a copolymer, a ceramic green sheet made of such ceramic precursor composition, a method for the production of such ceramic green sheet, and a ceramic sheet produced by calcining such ceramic green sheet. Osaka at Abstract. Osaka discloses that the individual particles of the ceramic powder as raw material are desired to be uniform in particle diameter and to have a homoaxially spherical shape. Osaka at column 3, lines 48-51.

However, Osaka is silent about spacers and about sandwiching a green sheet between spacers while baking the green sheet. Thus, Osaka fails to suggest the independent Claim 5 limitation of "sandwiching a green sheet to be baked by spacers; and baking the green sheet to be baked while being sandwiched, wherein the spacer is a green sheet or a calcined sheet comprising *spherical* ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a main component".

In addition, Osaka fails to suggest all the limitations of independent Claim 1. An object of Osaka is to provide a ceramic sheet which is generally free of defects from a *macroscopic* viewpoint with respect to the surface of the ceramic sheet. However, Osaka fails to suggest providing a ceramic sheet free of defects from a *microscopic* viewpoint, which is an object of the present invention. Thus, Osaka fails to suggest the independent Claim 1 limitation of "a ceramic sheet having not more than 5 defects in an area having a length of 30 mm or less, the defect being detected based on an image obtained with a charge coupled device (CCD) camera".

Because Osaka fails to suggest all the limitations of independent Claims 1 and 5, Osaka fails to have rendered obvious the claimed invention. Therefore, the rejection under 35 U.S.C. §103(a) over Osaka should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the rejection.

Claims 1-10 are rejected under 35 U.S.C. §103(a) over JP 8151270 ("Kazuo-270"). In addition, Claims 1-10 are rejected under 35 U.S.C. §103(a) over JP 8151271 ("Kazuo-271"). Applicants respectfully traverse these rejections because the cited prior art fails to teach or suggest the independent Claim 1 limitation of "a ceramic sheet having not more than 5 defects in an area having a length of 30 mm or less, the defect being detected based on an image obtained with a charge coupled device (CCD) camera". In addition, the cited prior art

to suggest the independent Claim 5 limitation of "sandwiching a green sheet to be baked by spacers; and baking the green sheet to be baked while being sandwiched, wherein the spacer is a green sheet or a calcined sheet comprising spherical ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a main component".

Kazuo-270 and Kazuo-271 are directed to large ceramic sheets having less than 100 μm swell height (waviness) and less than 0.1% warpage. Waviness and warpage are defects characterizing the ceramic sheets as a whole.

However, Kazuo-270 and Kazuo-271 are silent about suppressing superficial flaws that are recognizable by a CCD camera. Thus, Kazuo-270 and Kazuo-271 fail to suggest the independent Claim 1 limitation of "a ceramic sheet having not more than 5 defects in an area having a length of 30 mm or less, the defect being detected based on an image obtained with a charge coupled device (CCD) camera".

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Kazuo-270 and Kazuo-271 also fail to suggest all the limitations of independent Claim 5. Kazuo-270 and Kazuo-271 disclose forming ceramic sheets by placing green sheets between porous sheets. However, Kazuo-270 and Kazuo-271 are silent about the configuration of the powder used as a raw material for the porous sheets, and do not even implicitly suggest the shape of the powder. Furthermore, Kazuo-270 and Kazuo-271 provide no correlation between powder shape in the porous sheets and defects in the resulting ceramic sheets. Thus, Kazuo-270 and Kazuo-271 fail to suggest the independent Claim 5 limitation of "sandwiching a green sheet to be baked by spacers; and baking the green sheet to be baked while being sandwiched, wherein the spacer is a green sheet or a calcined sheet comprising *spherical* ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a main component."

Because Kazuo-270 and Kazuo-271 fail to suggest all the limitations of independent Claims 1 and 5, Kazuo-270 and Kazuo-271 fail to have rendered obvious the claimed invention.

In any event, any *prima facie* case of obviousness based on the cited prior art is rebutted by the unexpected reduction in defects, "detected based on an image obtained with a charge coupled device (CCD) camera", appearing in a ceramic sheet produced in accordance with the claimed invention by sandwiching a green sheet between spacers comprising "spherical ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a main component".

As discussed above, the attached micrograph Exhibits show, respectively, spherical ceramic particles (particle diameter: 0.7 μm) used in the present invention (NS-SAL), and alumina having no definite form (product of Showa Denko Co., Ltd., particle diameter 55 μm)(AL-15-2), which was used in Comparative Example 1 of the present invention. The micrographs show that the spherical ceramic particles used in the present invention have a shape close to a round shape, whereas alumina having no definite form as used in Comparative Example 1 has corners because the alumina is not aggregated into a spherical shape.

The general technology of producing ceramic powder produces particles having no definite form. Products available on the market are generally particles having no definite form. It is not common practice to produce spherical particles which are close to a round shape having a particle diameter of 0.1 to less than 5 μm .

The specification at page 35, Table 2, shows that all the sections of the ceramic sheet of Example 1, prepared by sandwiching green sheets between spacers including the recited "spherical ceramic particles having an average particle diameter of 0.1 to 5 μm or less as a

main component", have 5 or less defects. Specification at page 33, Table 1 and page 36, lines 1-2.

Contrary to this result, some sections of the ceramic sheets of Comparative Example 1, prepared by sandwiching green sheets between conventional spacers including particles of no definite form, had 5 or more defects. Specification at page 33, Table 1 and page 36, lines 2-4. As seen in the specification at Table 3, the ceramic sheet of Examples 1 to 3 had larger bending strength and Weibull modulus than those of Comparative Examples 1 and 2, while having less cracks and checks. Specification at page 38, lines 1-4.

Because the cited prior art fails to suggest the remarkable reduction in defects, "detected based on an image obtained with a charge coupled device (CCD) camera", appearing in a ceramic sheet produced in accordance with the claimed invention by sandwiching a green sheet between spacers comprising as a main component "spherical ceramic particles having an average particle diameter of 0.1 to less than 5 μm as a main component", any *prima facie* case of obviousness based on the cited prior art is rebutted.

Because Kazuo-270 and Kazuo-271 fail to suggest all the limitations of independent Claims 1 and 5, and any *prima facie* case of obviousness based on the cited prior art is rebutted, Kazuo-270 and Kazuo-271 fail to have rendered obvious the claimed invention. Therefore, the rejections under 35 U.S.C. §103(a) over Kazuo-270 and over Kazuo-271 should be withdrawn. Applicants respectfully request reconsideration and withdrawal of the rejections.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Marked-up copy of amendments

Abstract

Micrographs (two pages)



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